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OBSERVATIONS ON RISK CHANGES, 1939 NEEDLE GROWTH AND NEEDLE FUNGUS ON PONDEROSA AND JEFFREY PINE TREES, BLACK'S MOUNTAIN EXPERIMENTAL FOREST

(Comments by Wagener attached.)

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BERKELEY, CALIFORNIA
JUNE 13, 1940

File
4-5. db19a

Blue cones

cc. Mielke
Craighead
Dunning
Keen
Bongberg

OBSERVATIONS ON RISK CHANGES, 1939 NEEDLE GROWTH AND NEEDLE FUNGUS ON PONDEROSA AND JEFFREY PINE TREES, BLACK'S MOUNTAIN EXPERIMENTAL FOREST

1939 NEEDLE GROWTH

In the fall of 1939, J. W. Bongberg called attention to the incomplete or shortened 1939 needle growth on a pine tree in which fast growing flathead larvae were found in spite of an otherwise apparently healthy foliage condition. Examination of the growth record by J. W. Johnson revealed no 1939 diameter growth in that tree. The type of flathead gallery indicated to me that the species concerned was Melanophila gentilis. Previous work had indicated that species was one chiefly infesting windfalls, slash and dead but green host material. Bongberg stated recently that M. gentilis adults had emerged from bark from that tree, which had been placed in rearing last fall. He also noted the shortened 1939 needle growth on the tree infested by Matsucoccus bisetosus which has been reported on by McKenzie.

Bongberg and his field crew noted that these two trees were not exceptional and that markedly shortened 1939 needle growth occurred generally throughout the eastern Lassen plateau region in the vicinity of the Black's Mountain Experimental Forest. On a recent trip that condition was not found to be general south of the Bogard region of that area, in the Hat Creek area to the west, or on the Modoc plateau to the north. This short needle condition apparently indicates a response to some factor of local importance. Needles, even on reproduction, sometimes are not more than an inch long, previous normal growth having been four or more times that length. The number of needle fascicles does not seem to have been reduced, the abnormality being almost entirely in terms of length of needles.

1940 NEEDLE CAST

Another local condition which affects tree appearance and risk ratings is an abnormal needle cast which on some trees is removing all needles except the shortened 1939 growth and the partly formed 1940 needle complement. Specimens of old needles, which were submitted to J.L. Mielke of the Office of Forest Pathology, were identified by him as being infected by the needle fungus Hypodermella medusa. Mielke referred me to Darker's monograph on the Hypodermataceae of conifers(1) in which the following statements are made.

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(1) Darker, Grant Dooks. The Hypodermataceae of Conifers. Contribution from the Arnold Arboretum of Harvard University. I; pp 1-131, plates 1-27, June 15, 1932.

"Hypodermella medusa is an important species in some localities, but very little is known of its pathogenecity. It belongs to a group of species in which parasitism is highly developed and the few observations that have been made indicate that it behaves in the same manner as the others." H. ampla and H. montana are closely related species. The former "is the cause of a destructive needle casting. The attack is often so severe that all one year old needles are shed leaving only the needles of the current season." H. montana is "extremely prevalent in the Sierra Nevada Mountains in the region of the southwestern end of Lake Tahoe, California."

Under "Economic Importance" (of the group) Darker states, "..The infection (of some species) may be so severe that the annual growth may be seriously inhibited" (p. 108) and "The species of the genus Hypodermella are without exception worthy of more detailed study because every species appears to be an active parasite" (p. 109).

EFFECTS OF CURRENT CONDITIONS ON RISK APPRAISALS

Risk appraisals are based in considerable part on the condition of the needle complement and the length of needles. Thus any factor which causes shortened needle growth or an abnormal thinning or loss of needle complement causes changes which are considered in appraising the risk of individual trees.

In some parts of the Black's Mountain Experimental Forest, where high risk trees had been removed from the stand, Bongberg pointed out individual trees the risk ratings of which had been changed overwinter by the effects of the needle cast fungus. Generally, it is to be expected that the shortened 1939 needle growth also will result in more severe appraisals of risk than would otherwise be applied. However, as risk ratings must, to be effective, appraise the results of all factors deleterious to the tree health, these changes probably are real and may not be only apparent. The shortened needles undoubtedly are a symptom of some active factor and the needle cast, which leaves a seriously impaired complement, cannot help but be effective in reducing the health of the tree. It is disturbing if such changes occur frequently and as rapidly as did those recorded, for they make the problem of forecasting risk and loss for any long term period still more difficult to solve. If such changes occur only occasionally, their effects should be determined.

Although incomplete knowledge indicates the needle cast fungus is primarily a parasite, it is entirely possible that some weakened condition is necessary for its successful development. Thus there remains the possibility that the shortened needle growth is an immediate reaction on the part of the trees to some active factor and that the needle cast fungus is a secondary result associated with the same factor.

POSSIBLE CAUSE OF CURRENT CONDITIONS

Records of precipitation and temperature have been kept at the Black's Mountain Branch of the California Forest and Range Experiment Station since 1937. Through the kindness of Duncan Dunning, these were made available for study. A gross analysis of precipitation and mean monthly maximum temperatures indicates that climatic factors could well be responsible for disturbances in tree health leading to shortened 1939 needle growth, but fail to indicate anything definite concerning the role of the needle fungus.

Figure 1 consists of climographs constructed from the mean maximum air temperature and precipitation records kept at Hall's Flat, which is within the area in which shortened 1939 growth occurred and within a few miles of the areas in which the heavy needle cast has been observed. These climographs show late 1937 and early 1938 precipitation in amounts considerable enough to account for the relatively good 1938 diameter and needle growth. However, November and December of 1938 as well as the first four months of 1939 show marked deficiencies in precipitation although temperatures appear to have been about normal. These deficiencies could account for conditions which would lead to poor growth and decreased vitality. Precipitation in October, November and December of 1939 also was light. However, during the first four months of 1940 precipitation was fairly heavy and temperatures were slightly lower than in 1938 and 1939.

Inasmuch as a supply of weakened needles probably was available for infection by the needle cast fungus, due to the effects of previous precipitation deficiencies, and as moist cool weather was available for germination of spores in the spring of 1940, it is not clear which condition was primarily concerned in the needle cast outbreak. However, the problem of determining what effects the subnormal precipitation of 1939 and the needle cast of 1940 have on risk, subsequent mortality and tree health, can be determined experimentally if setups are planned and installed in the near future. Critical subnormal temperatures have already been recognized as factors modifying risk ratings. It is possible, if not probable, that critical climatic deficiencies and fungus outbreaks also may be vitally concerned in the risk changes of some individual trees.

Respectfully submitted,

K. A. Salman

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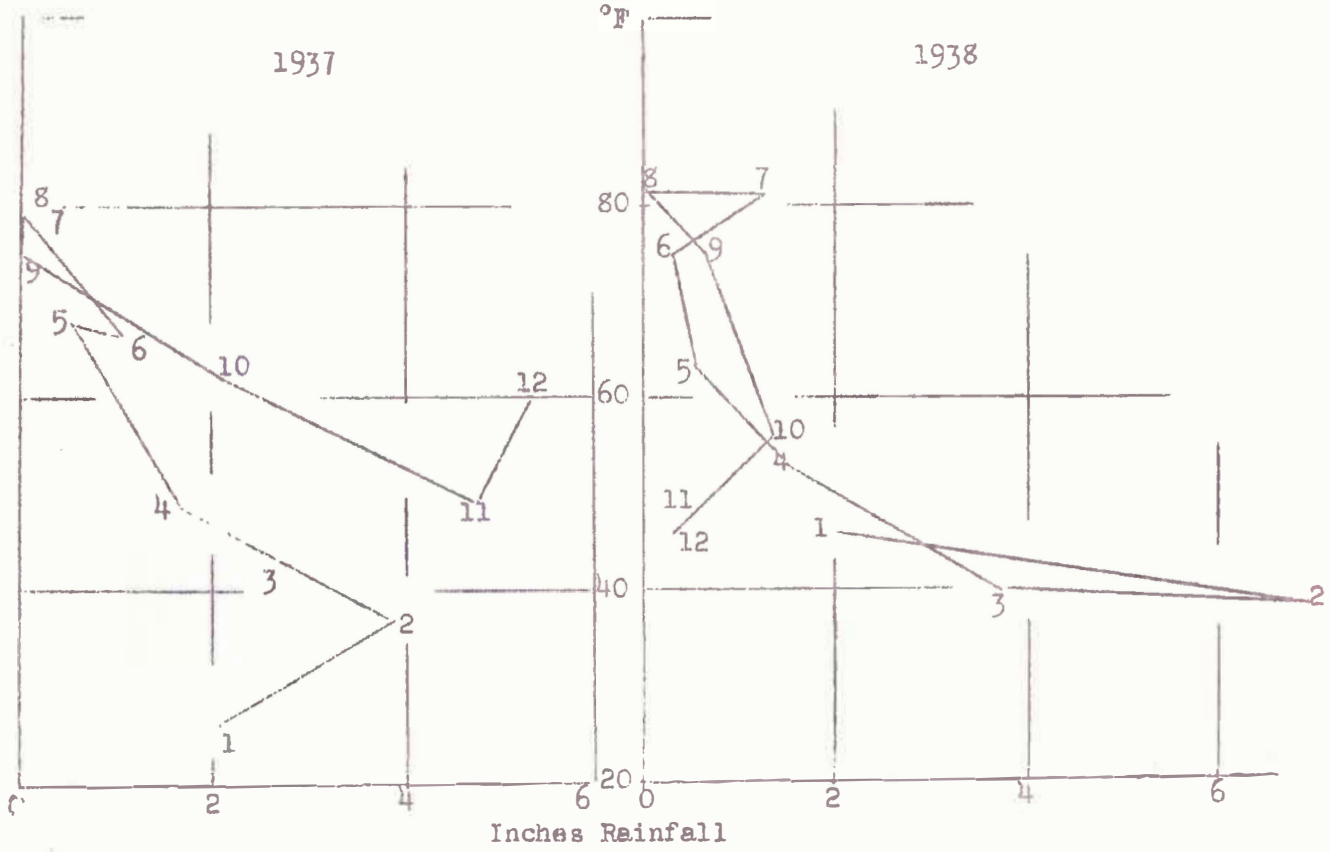
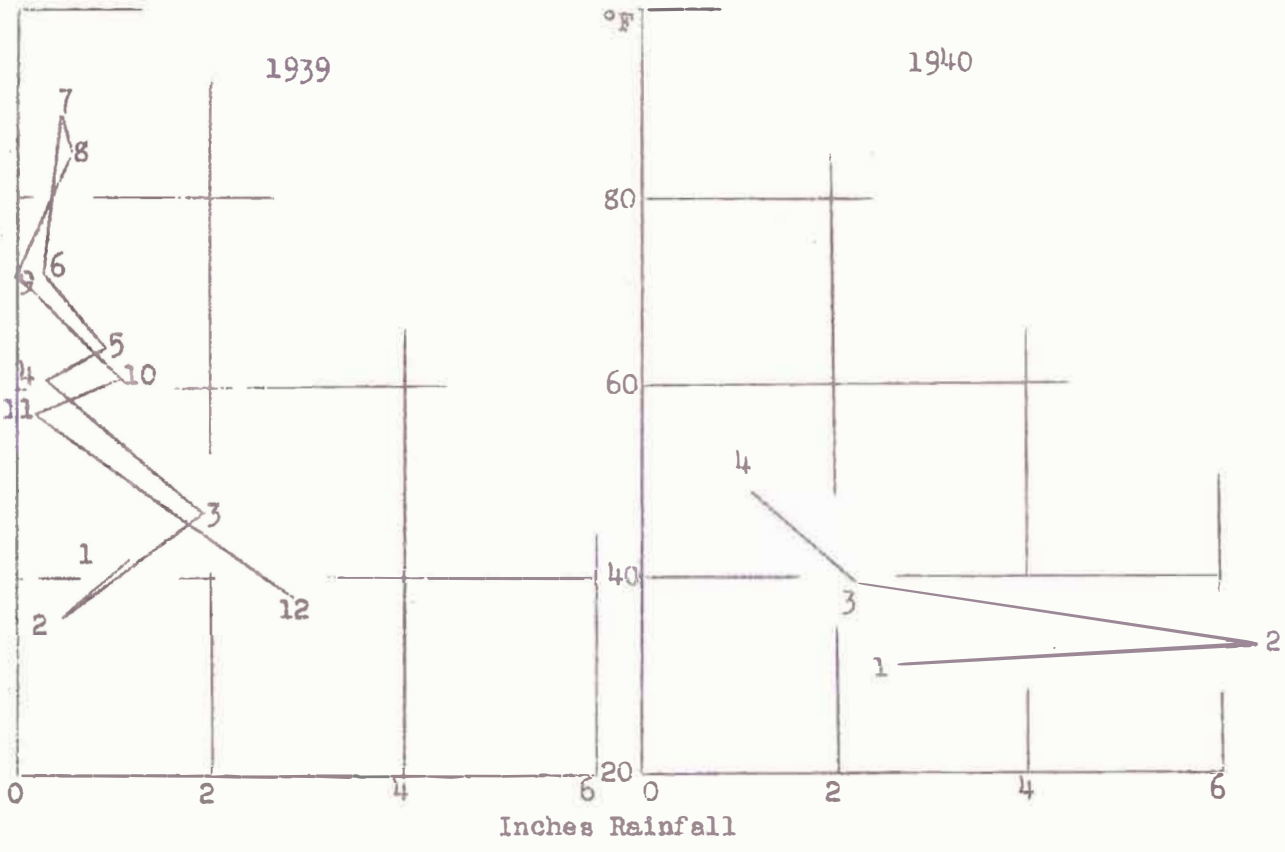
Entomologist

Berkeley, California
June 13, 1940

Figure 1. CLIMOGRAPHS
Precipitation and Mean Monthly Maximum Temperature
Black's Mountain Branch, California Forest and Range Experiment Station





Supplemental Notes for Memorandum of June 13, 1940, Re: Observations on Risk Changes, 1939 Needle Growth and Needle Fungus on Ponderosa and Jeffrey Pine Trees, Black's Mountain Experimental Forest.
(Exerpt from letter of June 17, 1940, by W. W. Wagener.)

I was very much interested in the reports forwarded with your letter of June 14 to Mr. Mielke and particularly in the one on "Observations on Risk Changes--" etc., at Black's Mountain since it ties in with some observations made by L. S. Gill and myself on the eastern Shasta in 1925 on trees affected by Hypodermella medusa. Incidentally, what I am certain is this same fungus was collected a number of times on ponderosa and Jeffrey pines in northeastern California by Boyce and others but unfortunately at the time Darker visited San Francisco while gathering the material for his monograph one herbarium box of specimens was overlooked in getting out the material for him and no one since has worked over the material to supply definite identifications.

The area examined by Gill and myself, together with L.F.Kellogg, at that time Technical Assistant on the Shasta, lay about 2 miles east of Sharp Mountain and carried a pure stand of ponderosa pine that had been marked for cutting. You may be interested in the part of the notes referring to Hypodermella medusa which we made at that time on the pathological condition of the stand.

"Hypoderma (Hypodermella medusa) is general over the area but is quite selective in its action, some trees being heavily attacked while others show little or no evidence of the presence of the fungus. Most of the trees have some Hypoderma present, especially on the lower foliage. In a few scattering cases the disease appears to have caused the actual death of trees. Many more are showing signs of severe distress, especially in the last year when drought conditions have aggravated the damage done by the fungus. The killing of affected needles has been especially marked in the last year and some trees have only a small tuft of short stubby needles at the extreme tips of the twigs still green, all others having died. The interference with growth is not a recent thing in the badly affected trees, however, and while the action may have been a little more severe during the past year than previously, there had been a pronounced retarding of growth evident for some time. This has manifested itself in a lessened diameter growth and in a more narrow crown with large numbers of very slender twigs bearing only short tufts of needles at the tips. Not all badly affected trees present the same appearance, however. In some the tendency has been toward short stubby branches. such as exhibited by Lophodermium trees, while in others the branches are longer and very slender, with an abnormal number of weak side twigs. This does not continue to the extent of being classed as a witches broom formation, however. Killed needles do not appear to persist for a very long time after death and do not assume the curled, gray-whiskered appearance characteristic for Lophodermium injury. In the trees examined on the area only those needles killed during the past year seemed to be present."

At the time of our examination, which was on May 1, 1925, fruiting bodies were prevalent on 1923 green needles. In order to secure some idea of the effect on diameter increment affected and non-affected or only slightly affected trees were picked in pairs, each pair being as nearly the same in age as we could estimate. The uniformity of the site aided in making the selections reasonably comparable. The trees were mostly between 100 and 200 years of age, with DBH's of 6 to 24 inches. Site quality was judged to be about V. Increment borings of the paired trees were later taken and after measurement, showed the following differences in average growth rate between the two groups:

	Radial growth 1915-1924, inches.	Radial growth 1875-1884, inches.
Affected trees	.138	.445
Normal trees	.346	.485

It will be noted that whereas growth in the two groups was nearly the same in the period 40-50 years previous to the time of obsegvation there was a marked difference for the preceding 10 years. The number of fings that appeared to show the effect in the diseased trees varied from 6 to 45, suggesting that injury from the fungus had been going on for some time.

As a result of the observations on these trees I became convinced that locally the fungus might seriously reduce growth and perhaps increase the stand mortality rate but had not happened to run across any similarly affected area since. Judging by Boyce's collections and notes the disease must formerly have been rather common in the region around Bray before that county was cut over.

It seems very probable to me that the condition of shortened needle growth observed by Bongberg may have resulted from a combination of the effect of the dry 1939 season evidenced by your climagraph for that year and the effect of the Hypodermella. Our 1925 observations followed a very similar set of conditions as 1924 was very dry as you may remember. However, on the Sharp Mountain area abnormally short needle growth was noted only on the trees on which the Hypodermella was heavy and was not evident on trees not materially affected by Hypodermella. Since the characters of the crowns and twigs on most of the trees affected by the fungus indicated that the parasite had been acting for some years we concluded that drought was not the primary cause of the short needles.